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Managerial views of corporate impacts and dependencies on ecosystem services: a case of international and domestic forestry companies in China

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Abstract

This study investigates managerial views of corporate sustainability under the ecosystem services perspective, which is emerging as a key paradigm worldwide for environmental management and policy making. We analyse interviews conducted with 20 managers from domestic and international forestry companies operating with a plantation-based business model in China. Content analysis was employed to analyse the data, with a focus on four key areas: 1) interviewee familiarity with the ecosystem services concept; 2) their views of corporate dependencies and impacts on ecosystem services; 3) related business risks and opportunities; and 4) viability of existing instruments and practices that can be employed in detecting and addressing business impacts and dependencies on ecosystem services. Based on our empirical findings, we further refined a conceptual framework of the impact-dependency-response process between enterprises and ecosystems services. This framework holds broader operational value for developing company response strategies to ecosystem services impact/dependence assessment, ensuring that all issues are addressed comprehensively, and that related risks and opportunities are properly acknowledged.

1 Introduction

Biodiversity and ecosystem services have globally become key concepts in the sustainability agenda, with implications for private sector goals and strategies. The ecosystem services concept emphasises societal and economic dependence on natural ecosystems: human-driven biodiversity loss and alteration of ecosystem processes cause disruption in the benefits that humans obtain from nature, defined as ecosystem services. There is fairly abundant qualitative research on how managers view or perceive environmental and social sustainability (e.g. Banerjee, 2001; Brody et al., 2006; Gordon et al., 2013), with core emphasis on corporate communication with external stakeholders (e.g. Boiral,

2013; Lozano and Huisingh, 2011; Tschopp and Nastanski, 2013). These aspects, however, have not been analysed from the emerging and holistic perspective of ecosystem services. Furthermore, there is no context-specific information on perceived corporate impacts and dependencies on biodiversity and ecosystem services, particularly from a sector and regional perspective. Our contribution to address this research void is a case study investigating manager views of the impacts and dependencies concerning plantation-based forestry on ecosystem services in the context of China, a leading emerging country.

China represents an interesting set-up for investigating the linkages between natural resources and businesses. During the past decade China's fast-expanding market has attracted a flow of domestic and foreign investments in pulp and paper manufacturing, based increasingly upon plantation-based business models (e.g. Toppinen et al., 2014; Zhang et al., 2015). Furthermore, the country is of high interest due to its national and regional forest conservation and re-forestation policies, from logging bans to eco-compensation schemes, with implications to industrial plantation development (Yang et al., 2010). China has the largest forest plantation area in the world, occupying 38% of national forest coverage (FAO, 2015). Globally, fast-growing plantations are aimed at maximising timber production: they contribute to 50% the global wood and fibre supply, representing only 7% of the world's forest coverage (Carle and Holmgren, 2010). The plantation area is expected to increase in the future, especially in Asia (Bauhus, et al., 2010). However, the introduction of monocultures with non-native species is criticised for their negative impacts on biodiversity, groundwater, soil, nutrient cycling and other ecosystem services (e.g. Brockerhoff et al., 2013; Cossalter and Pye-Smith, 2003; for a review, D'Amato et al., 2015). Thus, plantation-based forestry has experienced growing worldwide attention on its environmental and social impacts and its tenure arrangements (Korhonen et al., 2014).

Based on recent literature, there is further merit to analyse the drivers and processes of corporate sustainability (CS) and strategies for stakeholder engagement in China by also comparing domestic and international forest companies (e.g. Zhu and Zhang, 2015). Obtaining legitimacy may be particularly difficult in the developing institutions of emerging countries (Ahlstrom et al., 2008). Chinese firms were found to emphasize philanthropy with external stakeholders and stress CS when seeking legitimacy from internal stakeholders (Zheng et al., 2014). On the other hand, foreign-owned firms appear to perform financially better than domestic firms, which might result from more proactive environmental strategies, e.g. the adoption of voluntary sustainability standards and practices beyond local standards (Chen et al., 2011; Kim et al., 2015). However, the CS strategies of international companies often tend to reflect their home country issues, while local issues appear marginal despite the urge to "think globally, act locally" (Bondy and Starkey, 2012). Furthermore, a

case study on three multinational forest companies in China showed that CS agendas followed a standardised fashion, but the decision to integrate a plantation-pulp-mill model emerged to be a source of controversy (Toppinen et al., 2014). These issues give further impetus to our study.

Using the qualitative analysis of interview-based data from both international and domestic forest companies, our study aims to investigate manager views concerning four key areas: 1) familiarity with key concepts: sustainability, biodiversity, ecosystem services, ecosystem approach; 2) views of corporate dependencies and impacts on ecosystem services; 3) related business risks and opportunities; 4) viability of existing instruments and practices that can be employed in detecting and addressing business impacts and dependencies on ecosystem services, and related risks and opportunities. We also assess if and how manager views are influenced by the company's ownership and institutional background, i.e. whether differences exist between international and domestic companies. While our findings are context-specific and therefore non-generalizable, we developed a conceptual framework that holds operational value for assessing company responses to specific sustainability issues, and ensuring that all issues are addressed correctly and comprehensively. The study also offers a reflection on the implications of the ecosystem services approach for CS, in particular for forest companies operating in the context of emerging countries.

2 Theoretical background and key concepts

The ecosystem services concept, bridging natural sciences and economics, is employed to support nature conservation, in coexistence with development (Braat and de Groot, 2012). Though not denying the intrinsic value of nature, the ecosystem services concept is a utilitarian framing of natureⁱ, where natural systems are deemed to contribute to economic and social well-being of human beings. This includes the capacity of ecosystems to provide food, fibres, clean water; to regulate local and global climate, maintain soil, water and nutrient cycles, control pests and diseases; to generate spiritual, aesthetic and cultural value. The Millennium Ecosystem Assessment (MA, 2005), a study on the global status and importance of ecosystems to human beings led by the United Nations Environment Programme (UNEP), classifies ecosystem services into four categories: *provisioning services*, such as food, timber and non-timber products, fuel, genetic resources; *regulating services*, e.g. water purification and regulation, climate, extreme events and disease mitigation and regulation; *supporting services*, e.g. primary production and nutrient cycling; and *cultural services*, e.g. eco-tourism and recreation, aesthetic and spiritual values.

The ecosystem services concept is experiencing escalating scientific and political momentum. Research on ecosystem services is growing exponentially, dissecting the implications, applications and limitations of this concept (e.g. Braat and de Groot, 2012; Daily and Matson, 2008;

de Groot et al., 2010; Farber and Costanza, 2002). National and regional governments are oriented towards integrating ecosystem services-based tools into public policies, e.g. natural capital accounting and market-based instruments (TEEB, 2011; Waage and Stewart, 2008). In the global political agenda, ecosystem services are being mainstreamed under the Rio+20 concept for a Green Economy. Furthermore, the Convention on Biological Diversity has adopted an action framework based on the ecosystem approach, which is “a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way.” This approach supports decision-making with its holistic view and by the engagement of relevant stakeholders.

In the private sector, some pioneering companies perceiving the relevance of the ecosystem services concept to the private sector have joined non-governmental organisations (NGOs), industry associations and other partners to explore corporate applications. Several reports have been issued by the World Resources Institute (WRI) and by World Business Council for Sustainable Development (WBCSD) on the linkages between business and ecosystem services. Such publications also related to guidelines, training material, tutorials and software that support companies in ecosystem services assessment, accounting and risk management (e.g. Hanson et al., 2012; 2014; WBCSD, 2009, 2011). Despite the fundamental responsibility of governments and civil society in managing public goods, such as biodiversity and ecosystems (van den Burg and Bogaart, 2014), the private sector is expected to have an increasing role in environmental governance worldwide, via of CSⁱⁱ.

Theoretical and empirical literature abounds on company rationale for engaging in CS (e.g. in the context of forest industry, Boiral et al., 2015; Brody et al., 2006; Dyke et al., 2005; Tuppurä et al., 2013, 2015). This area of research has been especially influenced by the increasing role of external stakeholders in defining corporate goals, providing legitimacy for corporate actions and social licence to operate (Dare et al., 2014; Freeman, 1984). In Table 1 we compare CS motivation from a business organisation perspective (adopted from Brønn and Vidaver-Cohen, 2009) and from an ecosystem services perspective (adopted from Hanson et al. 2012; TEEB, 2012). The table shows that, despite the diverse terminology, the two classifications are similar and overlapping. As the perspectives of business organization and ecosystem services are coherent with each other, in our conceptual framework and empirical findings we have chosen to refer to the classification proposed by Hanson et al. (2012) and TEEB (2012). The utilitarian motives for CS include institutional viability (i.e. compliance with regulation, maintenance of reputation) and instrumental or strategic perspective (e.g. securing operational continuity, responding to market forces, seeking financial opportunities). Furthermore, motives for CS may be guided by moral values (Brønn and Vidaver-Cohen, 2009;

Hemingway and MacLagan, 2004). It has to be noted, however, that the sources of altruism are various and they can partly be motivated by selfishness or social norms (Margolis 1982).

Table 1 Motives for business engagement in sustainability issues: a comparison of two different classifications.

View	Business organization perspective (Brønn and Vidaver-Cohen, 2009)	Ecosystem services perspective (Hanson et al., 2012; TEEB, 2012)	Example
Utilitarian or Extrinsic	Institutional viability	Regulatory Reputational	Preventing future regulations and criticism arising from civil society
	Instrumental or strategic perspective	Operational Market Financial	Securing resources & continuity of operations; attracting sustainability-driven customers and financiers.
Altruistic or Intrinsic	Moral (internal belief not conditioned by socio-cultural norms)	NA*	“The right thing to do”; “Give back to society”

* Though not explicitly excluding the existence of a moral dimension of business, this is not discussed in Hanson et al., 2012 and TEEB, 2012. The existence of a moral dimension is controversial, but some authors find it a solid reason for CS (e.g. van de Ven and Graafland, 2006).

According to van den Burg and Bogaart (2014), the question is open on whether the business case for sustainability actually stands and how propulsive it is and will be in the future. From a utilitarian perspective, there is emerging evidence of positive relationship between CS engagement and successful economic performance through the improvement of existing practices, innovation and provision of business opportunities, management of customer demands, and enabled access to sustainability-oriented financing opportunities (Kim et al., 2015; Li and Toppinen, 2011; Orlitzky et al., 2003; UNEP, 2015). However, it would be too naive to postulate that true sustainability always results in win-win situations, especially in the short-term (Banerjee, 2001). Sustainability can lead to decreased, constant or increased costs for businesses, and can be synergic, neutral or conflicting with economic goals (Baumgartner and Ebner, 2010), depending on the context and observed time scale. While short-term profit is unfit with the spirit of sustainability, companies must ensure their viability by meeting the needs of both current and future stakeholders (Dyllick and Hockerts, 2005). The

temporal dimensions of CS represents a source of potential trade-offs at individual, organizational, industry and societal level (Hahn et al., 2010).

In light of the emerging awareness of business' impacts and dependencies on the environment, previous literature has tentatively explored the linkages between biodiversity, ecosystems and business, by proposing the concepts of dependency/impact, risk/opportunity and response practice (Hanson et al., 2012; Houdet et al., 2012; TEEB, 2012; WBCSD, 2011; Winn and Pogutz, 2013). The underlying logic is that economic sectors directly and indirectly depend on ecosystems, while their activities may cause ecological impacts.

Business activities may have negative and positive *impacts* that create trade-offs among ecosystem services and society. For instance, intensive forest management for fibre production affects biodiversity, water and soil, but increasing economic activity may offer support to local development. Businesses simultaneously depend on the environment and society for biophysical and human inputs, e.g. natural resources, the buffer capacity of ecosystems and work force. Business *dependencies* on ecosystem services can be positive or negative. Positive dependencies from ecosystems can be considered as ecosystem services, which business should secure as contributing to company's viability. Negative dependencies can be considered as ecosystem dis-servicesⁱⁱⁱ such as forest fires, storms and pests (Houdet et al., 2012), leading to jeopardies that businesses strive to minimize. It should be noted that this impact-dependency terminology upholds only if applied from the business point of view, i.e. with business as the producer of impacts and recipient of dependencies. From consumers' or citizens' point of view ecosystem services contribute to human well-being by delivering basic materials, health and security, and good social relations (MA, 2015). Businesses' impacts and dependencies effect on ecosystem services, and thus on constituencies of human well-being.

The conceptual framework of our study, shown in Figure 1, offers a holistic five-step approach in merging existing concepts from both CS management and ecosystem services. *Assessment instruments* (step 1) can be employed in detecting or monitoring business impacts and dependencies on ecosystem services. From a business viewpoint, neglecting potential *impacts* and *dependencies* (step 2) can lead to business *risks* (step 3). Impacts/dependencies and related risks are influenced by context-specificity, including the geographical and ecological context, and the social, economic and cultural setting. *Response practices* (step 4) represent corporate actions that can mitigate impact and dependencies, and may provide business *opportunities* (step 5).

Generally risks precede response practices, because even though a more pro-active attitude in corporate sustainability would be desirable, companies have historically often reacted only after issues became significant to relevant stakeholders (Clarkson, 1995; Sethi, 1979; Husted, and

Cantú, 2006). On the other hand, opportunities occur after the response practice has been established. Risks and opportunity are therefore separated in the theoretical framework to highlight the causality of the process. For example, a forest company relies on the availability of water for plantation growth and industrial processes, while potentially exercising an impact on the quality and quantity of water resources. In the long run, business risks might emerge due to water scarcity, and the consequent disruption of operations or conflicts with relevant stakeholders. Response practices may include e.g. increasing efficiency and/or reducing water consumption to guarantee resource availability and operation continuity.

Business risks and opportunities, the choice of assessment instruments and response practices (steps 1, 4 and 5) are influenced by the CS strategies (e.g. proactive and reactive) (Baumgartner and Ebner, 2010) and operational context. The degree of scientific, societal and corporate level awareness of the interactions between business, society and the environment is also an the overarching variable of the framework. Complete definitions of key concepts are given in appendix.

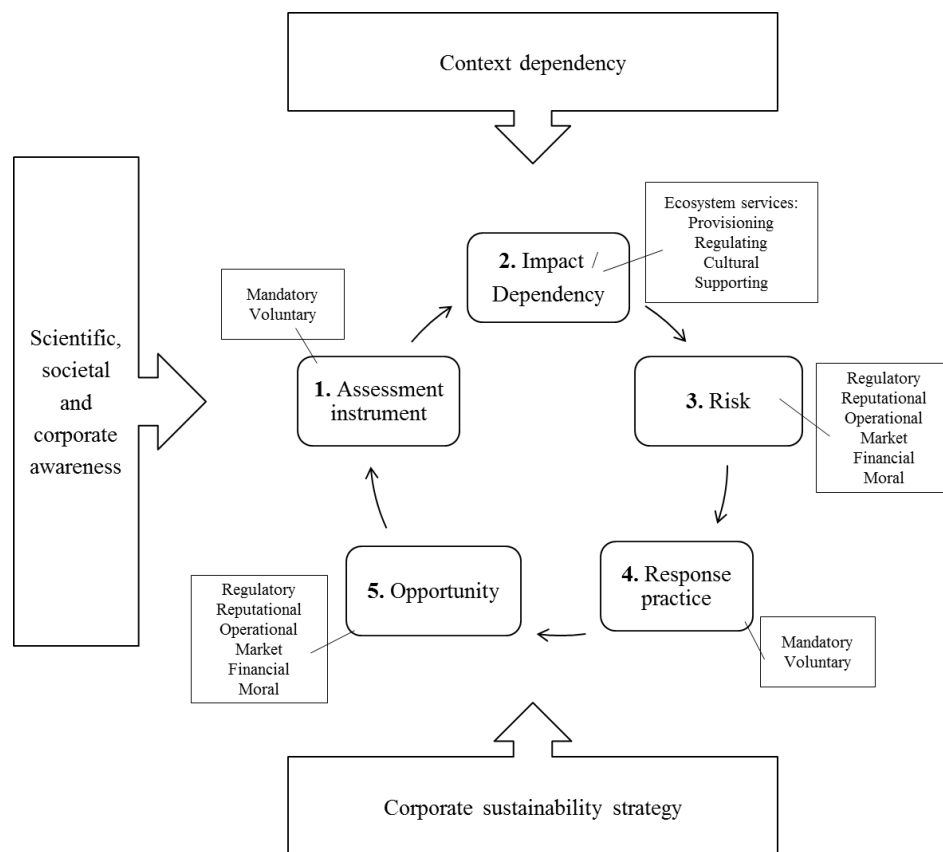


Figure 1 A holistic framework representing the process of assessing and responding to corporate impacts and dependencies on ecosystem services, and identification of related business risks and opportunities. Created based upon WBCSD, 2009; Hanson et al., 2012; Houdet et al., 2012; TEEB, 2012 and Winn and Pogutz, 2013.

2. Methodology

In our study we investigated the linkages between corporate sustainability and ecosystem services from the viewpoint of company managers. Our sample is a total of 20 informants from three domestic (N=12) and two international (N=8) forest companies operating in China (Table 2). Qualitative research is broadly used in organisational research to access peoples' experiences, perspectives and attitudes (Gummesson, 1991). We therefore followed the methodological approach suggested by relevant literature (e.g. Gioia et al., 2013) and employed in similar studies (e.g. Gordon et al., 2013).

The sample companies, including both domestic and international companies, were selected based on the presence of a plantation-based business model *in situ* and on managers' willingness to participate in the interviews. These companies operate in Southeast China, which is a suitable region for fast growing industrial plantations. Managers were selected with purposive and snowball sampling. The interviewees included senior and middle managers with different graduate educational backgrounds (e.g. forestry, engineering and environmental studies), and with substantial experience and responsibility in CS issues.

The interviews were conducted face-to-face and lasted approximately one hour each. The questionnaire was structured into four topics: 1) interviewees' familiarity with key concepts: sustainability, biodiversity, ecosystem services, ecosystem approach; 2) perceived corporate impacts and dependencies on ecosystem services; 3) risks and opportunities for business; and 4) existing instruments and practices related to ecosystem services. Topic 1 was based on close-ended questions, and managers were simply asked to state their level of familiarity with the concept (full, partial, none) and their opinions (good and important, neutral, negative and useless). As we were merely interested in the subjective views of the interviewees, we did not ask follow up questions to assess the veracity or to gather a deeper understanding of the statements. We expected managers to have a solid understanding of the terms sustainability and biodiversity, but likely less familiarity with ecosystem services, since this is a recent concept.

Topics 2, 3 and 4 were explored with open, semi-structured questions. Before the interview, managers were provided with the questionnaire in Chinese or English, and with an explanation of key concepts, such as ecosystem services, and corporate impacts and dependencies.

Table 2 Interviews conducted with N=20 managers from domestic and international forest companies in Southeast China.

Company ownership	Company ID	Interviewees (N)
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International	Company A	4
	Company B	4
Domestic	Company C	1
	Company D	7
	Company E	4 *
Total		20

*Group interview

The unit of analysis was a manager; in one case, however, four managers from one company were interviewed in a group. Data from topic 1 on interviewees' familiarity with key concepts were calculated as the percentages of managers that were fully, partly or not familiar with the key concepts, and the percentage of managers that considered them good and important, neutral, or negative and useless. This analysis only offers exploratory and very preliminary insights, which, however, may provide suggestions for future research.

In contrast, interview data from topics 2, 3 and 4 were analysed using content analysis and specifically coding (Krippendorff, 2003). The analysis was abductive (Mayring, 2000), as it was an iterative process with the data informing the theory, and the theory explaining the data. In abductive research there is a component of theory-driven analysis, as in suitable theories partly exist in literature to describe the phenomenon. In the context of our paper, for example, literature is available regarding the ecosystem services concept and classification and the concept of corporate impacts and dependencies. On the other hand, the coding process implied an iterative approach (Gioia et al., 2013): the interviews were thoroughly read to develop codes and consolidate them into themes; existing literature was used to support the interpretation of data, while the findings contributed to further developing the conceptual framework (Section 2). We proceeded in the following manner: 1) from the interviews we identified sentences or passages referring to either impacts and/or dependencies on ecosystems; or to business risks and/or opportunities; or to assessment instruments and/or response practices. We categorised the impacts and dependencies as either positive or negative, and identified the ecosystem service(s) they referred to (based on the MA 2005 classification). We categorised business risks and opportunities according to the Hanson et al. (2012) classification. Finally, we categorised assessment instruments and response practices as mandatory or voluntary; and, as performed internally by the company or externally by a third party; and, as useful in assessing or responding to impacts and dependencies.

After conducting analysis, we could confirm that saturation of data was reached also in this case for the main areas of inquiry. In our study, data saturation was determined by examining the

variation within the data, and whether this could be explained by the theoretical framework (Saumure and Given, 2008). Saturation of data can be generally achieved at a relatively small sample (20-30 interviews) (Marshall et al., 2013) when questions are narrowly framed to a well specific focus, or if the sampled group has a common background, as in our study.

Methodological limitations in research may affect the validity and reliability the results. To ensure the validity of our findings we adopted the following measures: 1) Prior to the study the questionnaire was tested by local experts; 2) Interviews were conducted either in English or in Chinese according to the interviewee's preference; 3) The software Opencode version 3.6 was used to facilitate systematic analysis of the data; and 4) When applicable, data were triangulated with sources such as corporate reports or interviews with other stakeholders.

The following aspects were taken into account to increase the reliability of the data collection: 1) companies and interviewees were assured anonymity; 2) Interviews were recorded when allowed by respondents (otherwise a written record was made of the answers); and 3) The translation of the interview material was handled by an experienced researcher, whose mother tongue is Chinese. Having lived and worked in Europe for over 20 years, she is also fluent in English. Translation is particularly critical in studies drawing from the meaning and nuances of language, on thematics such as emotions, feelings, personal thoughts and reflections (van Nes et al. 2010). Even though dealing with views, opinions or perceptions, our research focuses on topics such as ecosystem services, forest industry, and forestry operations, which utilize a technical language for which formal Chinese-English translation is already established. Our translator was also particularly familiar with sector-specific and technical jargon. Therefore, in our opinion, translation did not cause any loss of fundamental information.

Finally, regarding the reliability of the results, findings were presented as quotes in the results section to ensure better authenticity and transparency. While interviewees' talkativeness on specific topics varied according to their different levels of skills, experience and attitude to disclosure, the overall quality and quantity of data can be assessed as sufficient for the purpose of this analysis.

3. Results

3.1 Manager familiarity with key concepts

Managers' familiarity with the key concepts of biodiversity and sustainability was found to be similar across international and domestic managers (Table 3). Almost all managers were familiar with the concept of sustainability and it was considered good and important by all. Nearly all were also familiar with biodiversity and considered it positively. However, managers working in domestic companies were either partly or not at all familiar with the concepts of ecosystem services and

ecosystem approach. Instead, all managers working in international companies were somewhat familiar with these concepts. Of the ten managers that considered that they were only partly familiar with the concept of ecosystem services, seven regarded the concept as good and important. All the managers that were not at all familiar with the concept regarded it as neutral.

Table 3 Manager familiarity with and opinion of key concepts.

Concept	Company ownership*	Familiarity with the concept			Opinion		
		Fully	Partly	Not	Good and important	Neutral	Negative and useless
Sustainability	International	100%	0%	0%	100%	0%	0%
	Domestic	92%	8%	0%	100%	0%	0%
Biodiversity	International	83%	17%	0%	83%	17%	0%
	Domestic	83%	17%	0%	100%	0%	0%
Ecosystem services	International	33%	67%	0%	67%	33%	0%
	Domestic	0%	50%	50%	42%	58%	0%
Ecosystem approach	International	17%	83%	0%	50%	50%	0%
	Domestic	0%	33%	67%	33%	67%	0%

* Managers from domestic companies, N=12; managers from international companies, N=6 (two respondents did not answer this question).

3.2 Views of corporate dependencies and impacts on ecosystem services

All interviewees provided examples of positive dependencies that their companies have on ecosystem services. The positive dependencies mentioned by the interviewees mainly included provisioning and regulating services, even though five interviewees mentioned supporting services such as geographical and climatic conditions (i.e. altitude, heat, precipitation, sunlight, temperature, weather). Examples of positive dependencies included biodiversity, energy, available tree species and genetic resources, and water. Relation to land was also considered as a dependency, and it was a recurrent and central element in the interviews, particularly associated with the engagement of and occasionally also conflicts with local communities. We further discuss the land issue in the findings regarding business risks (Section 3.3). Negative dependencies on natural systems were related to regulating services, and included forest fires, floods, typhoons, pests and diseases. Since the answers on dependencies from managers working in domestic and international companies were similar, we have not separated them in Table 4a.

Few interviewees specifically addressed company impacts, either positive or negative, which were mainly related to provisioning and regulating ecosystem services, and again no clear differences were found between managers working in domestic and international companies (Table 4b). Negative impacts concerned with biodiversity, nutrients, air, soil, water and, in general, over-exploitation of natural resources and land degradation. Positive impacts include timber production and carbon sequestration. A lack of technical verifiability of the negative impacts at the organisational level was complained by some managers; in other cases, the negative environmental impacts were coupled in the discussion with positive social impacts (e.g. employment, local development). Impacts and dependencies were always expressed at the organisation level. The landscape level was mentioned in reference to negative impacts, as one interviewee pointed out: *“There are no groundwater problems from Eucalyptus, but from agriculture”*; this was also voiced by another interviewee: *“Because of the tropical climate, rainfalls are sufficient to restore water resources”*. Furthermore, no interviewee addressed impacts or dependencies from a supply chain perspective. Three respondents also mentioned aspects that are not strictly related to ecosystem services, but rather to the company’s engagement with local communities: labour (positive dependency), relationship with the local villagers (positive and/or negative dependency) and the issue of land competition and locals’ tenure rights (negative impact).

Table 4a Managers’ views of positive and negative dependencies on ecosystem services.

Dependencies	Mentioned by N managers	Examples of the quotes	ES category
Positive			
Biodiversity’s role in mitigating natural hazards	1	<i>“Species diversity significantly helps reduce pests and diseases, forest fires and soil erosion.”</i>	Regulating
Energy	2	<i>“Wood-processing requires energy”</i>	Provisioning
Geographical location & climatic conditions	5	<i>“Geographical environment and weather [among others] are necessary natural resources for forest industry’s production and operations.”</i>	Supporting
Land	16	<i>“The acquisition of land is the number one priority for our company.”</i>	-
Landscape	1	<i>“Natural resources as an important input for forest enterprises include [among others] landscape.”</i>	Cultural
Seedlings	4	<i>“The main natural resources as input of forest enterprises are [among others] timber, including seedlings.”</i>	Provisioning
Soil	9	[among others] <i>“the ecological structure of the soil”</i>	Regulating
Timber	12	<i>“Wood is needed for paper mills.”</i>	Provisioning

Tree species & related genetic resources	5	<i>“In terms of genetic resources, we have introduced Eucalyptus urophylla, Acacia mangium and Populus X canadensis. They are all fast-growing tree species suitable for small- and large-scale commercial plantations.”</i>	Provisioning
Water	14	<i>“Indirect input: water”</i>	Regulating
Negative			
Forest fires	2	<i>“Forest fires are usually not major events, but seasonal, often due to the concurrence of the dry period and the Qingming festival.”</i>	Regulating
Floods	1	<i>“Typhoon season occurs from June to October.”</i>	Regulating
Pests & diseases	2	<i>“Plant diseases and insect pests are of great concern.”</i>	Regulating
Typhoons	2	<i>“The plantation is subject to typhoons and floods that influence operations, although not seriously.”</i>	Regulating

Table 4b Managers’ views of positive and negative impacts on ecosystem services.

Impacts	Mentioned by N managers	Examples of the quotes	ES category*
Positive			
High rate of timber production	1	<i>“The impacts of forest enterprises can be positive or negative. From an ecological perspective, the impacts are negative. From an economic perspective, fast-growing plantations enable high output rates.”</i>	Provisioning
Carbon	1	<i>“The company estimated the carbon stock in the plantations”</i>	Regulating
Negative			
Air quality	2	<i>“Forest industry’s dependence on natural resources affects and contributes to the deterioration of the environment, like land degradation, air and water pollution.”</i>	Regulating
Biodiversity	1	<i>“Forest enterprises have unavoidable impacts on [among others] biodiversity.”</i>	-
Nutrient cycling	1	<i>“Fertilisers are heavily employed over a 7-year rotation period”</i>	Regulating/Supporting
Over-exploitation of natural resources & land degradation	2	[Local environmental problems such as] <i>“the over-exploitation of forest, land and other natural resources.”</i>	-
Soil	5	<i>“The environmental impact comes from Eucalyptus. Their fast growth require fertilisers, which impact the soil and water”</i>	Regulating
Water quality & Water quantity	7	<i>“Rainfall and groundwater are both affected by plantations”</i>	Regulating

*Based on MA 2005 (Section 2).

3.3 Views of business risks and opportunities

All interviewees provided examples of associated business risks, while only few interviewees gave examples of business opportunities. Perhaps it is assumed, as one interviewee stated, that “opportunities and risks are two aspects of one issue, either of which can transform into the other”. Answers concerning business risks were similar between managers from domestic or international companies (Table 5). However, only international company managers mentioned the importance of locals’ opinions (1 interviewee) and the pressure from society and transparency issues (3 interviewees). Most managers agreed that when handled poorly, land tenure acquisition processes might lead to a business risk. Specifically, forest enterprises cannot buy land in China; they can only stipulate leasing agreements with the state, individuals or communities to acquire land use rights. Plantation areas are therefore typically small and parcelled (Tan et al. 2006). Contracts stipulated with individuals or communities last several decades, and involve a chain of intermediaries, which are respected or powerful local people. If dishonest, intermediaries may cause conflicts between the locals and the companies. Moreover, since land prices have increased during the past decade, there have been instances where landowners have wished to rescind or re-formulate the contracts. As land use is determined by the government, any future changes in land use policy, e.g. from productive to conservation purposes, can be understood as possible risks, as also mentioned by some managers. Other regulatory risks mentioned in the interviews included securing harvesting quota and stricter environmental requirements (e.g. promoting the use of native species) set by the state. In China, the total harvest quota is set at the regional level and it is re-adjusted every five years. However, two respondents from international companies stated that the current harvesting quota was sufficient.

Concerning business opportunities, opinions about carbon trading were cautious, despite a general positive attitude, like the following quote illustrates: *“Theoretically, forest enterprises should have the potential to play an important role in climate change mitigation and carbon emission trading”*. Three interviews illustrated carbon trading was not considered an appealing opportunity for forest industry, as pointed out by one interviewee: *“I would stay conservative for [the forest industry’s] potential role in the domestic carbon market”*. Certification was deemed as customer-driven, as one of the respondents stated: *“Certification has granted a ‘green passport’ for export to the United States”*. Certification was related to third-party engagement. Engaging with third parties, e.g. auditing companies, universities, research institutes, may contribute to reinforcing operation legitimacy and reputation. Complying with and anticipating regulations were additionally also mentioned as business opportunities.

Table 5 Manager views of business risks and opportunities arising from sustainability issues.

	Mentioned by N managers	Examples of the quotes	Type*
Risks			
Changes in land use policy & Logging bans	8	<i>“A change in policy regulation is a big risk. The government decides what land is set for productive or conservation land. However, the company must still respond to a certain environmental pattern on productive land”.</i>	Regulatory
		<i>“The logging ban will place significant pressure on the domestic structure of timber supply and demand”</i>	
Competition for financing	2	<i>“Financing is becoming more and more competitive”</i>	Financing
Difficulties in land acquisition and maintenance	11	<i>“The significant decrease in available land, the use of intermediaries in land acquisition and land tenure [...] present a challenge”</i>	Operational
Higher prices due to natural resources scarcity	1	<i>“The reduction of natural resources will lead to soaring prices and resource plunder.”</i>	Operational
Locals’ opinion	1	<i>“The locals’ opinions regarding Eucalyptus are very negative [...]. However, the company conducted studies that did not find any major impact on water”.</i>	Reputational
Operation disruption due to natural hazards	5	<i>“[...] typhoons in 2013 cause considerable damage and loss. Pest control remains the most difficult and challenging thing after every typhoon.”</i>	Operational
Pressure from society and transparency issues	3	<i>“Forest and pulp-paper companies very much depend on raw material and [...] local communities. The issue of social equality as well as open and transparent information should be strengthened”</i>	Reputational
Reduced productivity due to ecosystem degradation	2	<i>“Soil degradation can lead to a significant decrease in average production.”</i>	Operational
Securing harvesting quota	6	<i>“A big risk for companies is to secure a harvesting licence from the government.”</i>	Regulatory
Social issue	3	<i>“Social issues are a topic that have become more and more important.”</i>	Reputational
Stricter environmental requirements	4	<i>“Environmental regulations will likely become more and more stringent, covering all aspects.”</i>	Regulatory
Timber theft	4	<i>“The awareness of sustainable forest management is still very low at the local level and illegal logging and timber theft [from plantations] are common and frequent crimes.”</i>	Operational/Reputational
Opportunities			
Carbon trading	7	<i>“The company calculated the carbon stock on the momentum of carbon markets, but feasibility is a problem. In the future, the company might have interest in voluntary trading, but currently it is in a preparation phase.”</i>	Market

Customer-driven certification	3	<i>"Certification choice is customer-driven"</i>	Market
Comply with and anticipate regulations	3	<i>"Opportunities include to comply with the law and to do it even before any regulation occurs."</i>	Regulatory
Knowledge and technological transfer	1	<i>"Opportunities are seen in terms of international experience and experts that can provide, for example, new technology for the locals."</i>	Operational
Regional development	1	<i>"The expansion of plantations by forest companies will help local poverty alleviation, especially smallholders and local communities in developing regions."</i>	Reputational
Sustainable management	1	<i>"The better natural resources are sustained and managed, the less the risk associated with our operation."</i>	Operational
Third-party engagement	3	<i>The company relies on the university for long-term monitoring.</i> <i>"Third party verification or evaluation is very important."</i>	Reputational

*The classification is based on Hanson et al. (2012); TEEB (2012) (Section 2).

3.4 Assessment instruments and response practices

Currently, there are no instruments or practices in place explicitly dedicated to assessing or responding to business impacts or dependencies on ecosystem services. We therefore asked managers whether the existing regulatory or voluntary instruments or practices could hold any value for this purpose (Table 6). Mandatory instruments and response practices include Environmental Impact Assessment (EIA), diverse-species areas, and, to some extent, environmental monitoring. Implementation of voluntary instruments and practices was mentioned only by international companies, with the exception of certification. For instance, the managers of two international companies mentioned that buffer zones around water resources or sensitive areas (e.g. conservation, religious) were set up according to internal certification standards. Carbon accounting was mentioned by the managers in one international company. There is a challenge for incorporating carbon accounting, as one manager mentioned: *"The forest industry does not yet have a comprehensive tool for carbon emission calculation."* Another manager said: *"There are too many things unsolved (e.g. missing legislation, social equity, property rights, forest education, poverty gap at local, provincial and regional levels) that can slow down or postpone the building of a national carbon emission trading system"*. Technical difficulties and the high costs of environmental monitoring were also mentioned as barriers; companies thus often need to rely on universities or other research institutes for technical support.

Overall, a set of existing assessment instruments and practices especially focuses on impacts (Table 6). As one of the managers stated, *"Currently, there isn't any rule or regulation for [assessing] corporate dependence in China. On the other hand, corporate EIA is required by the*

law”. Another interviewee said: “*Environmental assessments still exclusively focus on corporate impacts. As a matter of fact, impacts and dependencies are equally important to know. But so far there is no relevant specification or guidance to assess corporate dependencies.*” However, it seems likely that some instruments might be employed in assessing dependencies: for example, environmental monitoring, mapping sensitive areas and monitoring natural hazards in plantations. An interesting response practice was raised by a manager of an international company, mentioning a “green fertiliser” project that reduces the use of chemical fertilisers by using “green alternatives”, even though he pointed out that “*these programmes are not employed as much currently, partly due to conflicts [with locals]; these [practices] are considered experimental, but difficult to manage*”.

Table 6 Assessment instruments and response practices for ecosystem services.

	Mentioned by N managers	Examples of the quotes	Type*
Assessment instruments			
EIA	7	<i>“Regulatory environmental assessment must take place before we can legally take over the forest land through leasing and before any further commercial plantation can be implemented.”</i>	Mandatory; external; assessment: impacts
Mapping sensitive areas	3	<i>“There is layered mapping of key issues (e.g. land, high conservation value forest, natural forest restoration plans, wild fauna and flora, species-rich areas.”</i> <i>“Graves are mapped and taken into account during operations”</i>	Voluntary; internal; assessment: impacts/dependencies
Monitoring natural hazards in plantations	2	<i>“The company keeps records of forest fires, also those occurring outside plantations.”</i> <i>“Pests/diseases: trends of attacks are monitored”</i>	Voluntary; internal; assessment: dependencies
Carbon accounting	2	<i>“The company has estimated the carbon stocks of the plantations. This is fairly easy to do. However, estimating emissions from operations is difficult, because the emission sources are very diversified.”</i>	Voluntary; internal; assessment: impacts
Environmental monitoring	5	<i>“There is cooperation with the university: plots have been set up (in the forests) to monitor soil and water quality. The plots are permanent and cover all operation stages from planting to tending to harvesting. It is also long-term monitoring.”</i>	Mandatory/voluntary; internal/external; assessment: impacts/dependencies

Resource inventory	1	<i>"The company monitors the quantity and quality of timber."</i>	Voluntary; internal; assessment; dependencies
Site planning	3	<i>"Prior to operations an internal social and environmental assessment is conducted" At first there is a planning phase that includes identifying the suitable areas for operation."</i>	Voluntary; internal; assessment; impacts/dependencies
Sustainability of the supply chain	1	<i>"The company checks the social and environmental sustainability of the contractors"</i>	Voluntary; internal assessment; impacts
Response practices			
Buffer zones	4	<i>"Buffer zones for water resources are established [against] soil and nutrient erosion and leakage, [and around] graves and high value conservation areas"</i> <i>"This is a voluntary practice and it follows internal standards e.g. regarding buffer width."</i>	Voluntary; internal; response: impacts
Certification	4	<i>(...) "external assessments include Forest Stewardship Council (FSC), International Organization for Standardization (ISO), Programme for the Endorsement of Forest Certification (PEFC)."</i>	Voluntary; external; response to impacts
Diverse-species areas	3	<i>"The company needs by regulation to create [areas with species other than Eucalyptus] e.g. with Acacia, pine, or bush land. This represents a cost for putting land aside; the environmental benefit is minimum because the land is still managed by the company in a plantation-like manner, for profit. A possible solution would be to rent the land that is designated by regulation for environmental protection to villagers for other purposes."</i>	Mandatory; external; response: impacts
Green fertilisers	2	<i>"A practice using legumes to boost fertility in soils was employed as a pilot project in some areas, as well as areas managed in synergy with cassava to encourage local involvement and mitigate artificial fertilisation."</i>	Voluntary; internal; response: impacts/dependencies
R&D	4	<i>"The company has an R&D project on hybrid clones for genetic improvement. Also, it is dedicated to the best silviculture operations and practices."</i>	Voluntary; internal; response: dependencies

*Based on our own classification.

4. Discussion

Our findings suggest that the interviewed managers of forestry companies are familiar with the concepts of sustainability and biodiversity, and also consider them important. However, they are less familiar (especially domestic companies' managers) with the emerging concept of ecosystem services, and its operational value to business remains not fully recognised. Vihervaara and Kamppinen (2009) reported similar findings for managers in the context of Finnish forest industry. This is understandable because the concepts of sustainability and biodiversity have had a longer time to penetrate the business community and society at large in comparison to that of ecosystem services. Despite the managers' low level of familiarity with ecosystem services, many interviewees still considered the concept to be important. However, those that were not familiar at all with the concept had a neutral opinion, which is a logical outcome from the viewpoint of social norm and social desirability. People perceive what is important to others and what is socially desirable even though they not necessarily have a deep understanding of the phenomenon. The concept of social norm is slightly different than that of social desirability. The first refers to view of social values, whereas the latter refers to respondents' aim to please the interviewer. On the other hand, if people are not familiar at all with the concept, they will not be able to formulate an opinion based on social norm or desirability.

The interviewed managers were able to identify some impacts, dependencies, risks, opportunities, assessment instruments and response practices related to the management of ecosystem services. Figure 2 represents an overview of the findings from the case study, embedded into the conceptual framework proposed in Section 2. We will next discuss our results according to the five different steps.

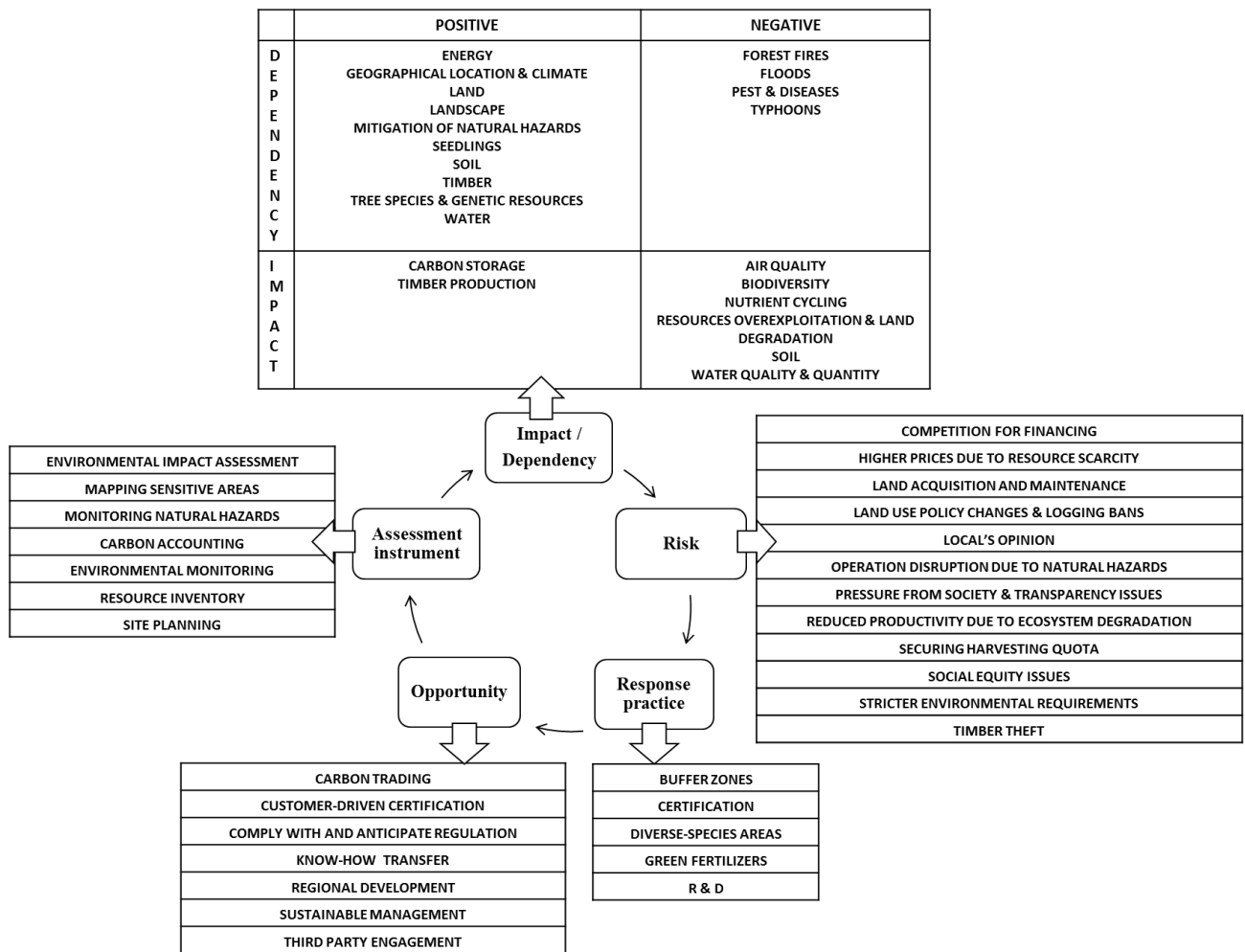


Figure 2 Summary of the findings based on our conceptual framework.

Based on our findings, forest-industry manager answers concerning impacts and dependencies substantially reflect the dominant issues currently addressed by CS management, i.e. fibres, water, carbon and biodiversity (D’Amato et al., 2015; Baumgartner and Ebner, 2010; Labuschagne et al., 2005; Toppinen and Korhonen-Kurki, 2013). Company energy-dependence and waste handling, normally central issues in CS, were not prominent in the interviews, since these focused on plantation forestry rather than forest industry in general (also including mill operations). Innovative elements recorded in the interviews included the identification of negative dependencies, for example natural hazards. In conceptualizations found in existing literature (e.g. Hanson et al., 2012; Houdet et al., 2012; TEEB, 2012; WBCSD, 2011; Winn and Pogutz, 2013), dependencies were defined as the reliance of companies on ecosystem services. In this sense, dependencies on ecosystems could increase or decrease, but are not classified as positive or negative. Even though seemingly simple, this view is more academically-oriented than that held by managers, because the concept of dependence is not completely specular to the concept of impact. For instance, if a woodland or

plantation area is damaged as a consequence of a storm of fire, company dependence increases as a result of resource scarcity. Such dependency is however not envisioned as positive or negative. Managers' view of dependency includes any factor affecting positively or negatively company's success. In other words, dependencies are the positive or negative effects of ecosystems on businesses. From this perspective, companies' extraction of resources is seen by managers' as a positive dependency, because it affects positively their company. It should however be noted that it is probably desirable for companies to minimize both positive and negative dependencies, including for example resource extraction and vulnerability to natural hazards.

Land use was a dominant theme, and was deeply linked to social and property rights issues at local level. Previous literature has already reported about irregularities and challenges arising from the land rental agreements between companies and the local villagers in China (Ping and Xiaobei, 2014).

Despite the anonymity of the interviews, managers were reticent to discuss negative impacts, a phenomenon also evident in official CS disclosure (Boiral et al., 2015). This may again have to do with managers' social desirability cognition, self-interest and fear of negative repercussions for the company in the context of China, as well as their actual unfamiliarity and lack of knowledge. The presence of a social desirability effect is suggested by the fact that some managers appeared to minimize company's impacts by coupling in their speech positive social and negative environmental impacts tightly together.

Interestingly, the main body of ecosystem service impacts and dependencies were articulated at the organisation level, but almost no discussion was carried out regarding the supply chain or the broader landscape level. This is in line with findings from CS analysis of supply chain management (Hourneaux et al., 2014): forest industry company disclosure on biodiversity and ecosystems typically focuses on the indirect impacts caused by operational activities, rather than direct impacts resulting from supplier and contractor activities.

Based on our findings, the identified business risks and opportunities can be understood as a mixture of regulatory, operational and reputational issues, while the role of markets (especially domestic) and sustainability-oriented financing is marginal. Even though a moral dimension is observed in precedent literature among the drivers for CS (Table 1), we did not record this type of information in our interviews.

There was indication that the adoption of forest certification in China is mainly driven by international markets. These findings are in line with what reported in existing literature (Chen et al., 2011; Toppinen et al., 2014). Based on FAO (2015) statistics, independently verified certification in China has started in recent years, 2010 for the national China Forest Certification Scheme (CFCS)

and 2013 for the international Forest Stewardship Council (FSC), and covers a rather limited forest area.

Even though the Chinese government has recently encouraged (especially state-owned) companies to integrate CS practices into core business functions (Zhu and Zhang, 2015), civil society still provides rather weak incentives for corporate environmental compliance. Pressure from international shareholders, customers and national governments, coupled with voluntary corporate practices can therefore be identified as the major drivers for improving CS performance (Earnhart et al., 2014).

Our findings about recognition of risks and opportunities are also in line with some insights provided in analysis of the forestry sector in the context of Guangxi province (Cossalter and Barr, 2005), according to which threats and weakness to the forest sector include a limited genetic resource-base, suboptimal species-site combination, the uncertainty of annual cutting permits' allocation, slow and difficult access to new plantation land, and complicated relations with local communities, including tensions over lease agreements.

Despite a general positive attitude among the managers towards CS, the role of the forest sector in carbon trading was yet deemed as uncertain or marginal. In 2011, China initiated pilot carbon trading schemes in seven provinces, but the forest sector is not included (Ecofys, 2013). Furthermore, there may be technical difficulties in accounting for carbon sequestration in plantation-based forestry, including taking into account the diverse sources of emissions, as well as the carbon storage that is dependent on the end product.

Overall, no main differences between international and domestic company manager views were recorded. However, managers from international companies were more aware of risks originating from locals' opinions and pressure from society and transparency issues. For example, they mentioned that their companies pay particular attention to the graves within the plantation area, to avoid conflicts with locals. Managers from international companies were also more prone to discussing voluntary assessment instruments and response practices, compared to managers from domestic companies. An explanation to this can be found in previous literature, where differences were found in company responses to sustainability issues, depending on firm ownership. For example, foreign companies operating in emerging economies are typically under closer scrutiny from governments and civil society, their efforts are therefore typically directed at enhancing sustainability and creating shared value, to ensure legitimacy and a social licence to operate (Bondy and Starkey, 2012; Kim et al., 2015), reflecting a pro-active company strategy (Hillman and Keim, 2001). A CS strategy additionally tends to vary with firm size. Larger companies have more societal and media visibility and tend to adopt pro-active environmental strategies under the pressure of civil society

stakeholders. Smaller firms instead are more responsive to value-chain, internal and regulatory stakeholder pressures (Darnall et al., 2010). Furthermore, the CS strategy can be determined by the intrinsic core company culture for sustainability or values of individual managers (e.g. Eccless et al., 2013; Morgan, 1993; Schwartz and Davis, 1981), but this approach was not targeted in this paper.

Based on these findings, we conceptualised our framework as follows (Figure 1): impacts, dependencies and risks are context-specific, thus influenced by the ecological, social, economic and cultural nexus in which companies operate. Companies operating in the same context will therefore likely share similar impacts and dependencies, and they need to identify local level CS issues to appropriately respond (Muller, 2006). However, the choice of assessment instruments and response practices is still influenced and shaped by their individual CS strategy agendas.

5. Contribution of this study and future research

The findings of this study confirm the increasing relevance for companies in natural-resource dependent business to understand and address the specific sustainability issues of the sector and adapt to the locations where they operate, either directly or indirectly. The concept of ecosystem services has become a key tool in environmental policy worldwide, and there is space for private sector contribution (Waage and Kester, 2014). This paper adopted a qualitative case study approach for investigating manager views of ecosystem services in the context of plantation-based forestry in an emerging economy of China. Even though the managers' answers were comprehensive, our empirical findings are highly context-specific and possibly non-exhaustive, and the ecosystem services concept is still likely to be peripheral in CS discourse or managers' mental models.

Based on our empirical findings and existing literature (e.g. WBCSD, 2009; Hanson et al., 2012; Houdet et al., 2012; TEEB, 2012 and Winn and Pogutz, 2013), however, we refined a conceptual framework of the interactions between enterprises and ecosystems (Figures 1 and 2). This framework has operational value in assessing company responses to ecosystem services-related issues also beyond the current context, to ensure that these are addressed correctly and comprehensively. There is a great need for the analysis of CS issues and the evaluation of related business response strategies (Maon et al., 2008; Sethi, 1979). Importantly, corporate response strategies should be in place even before impacts and dependencies have become significant, and not only after causality between company's activities and effects has been fully established. Problem assessment is thus a crucial, but difficult step. Our framework identifies inclusive categories of existing *assessing instruments* and *response practices* that can be employed in detecting and addressing business *impacts* and *dependencies* on ecosystem services and related *risks* and *opportunities*.

The emerging ecosystem services concept, increasingly employed by academia and policy makers, has further potential to create a paradigm shift in how companies and their stakeholders perceive ecosystems under the paradigm of CS. We further articulate this argument taking our framework as an example. A current challenge to CS is that it “remains resolutely anchored on firm- and industry-level behaviour, usually involving single issues like toxic emissions or climate change” (Whiteman et al., 2013, pp.308). The added value of using the ecosystem services approach in assessing impacts and dependencies is that it proposes a comprehensive list of ecological issues (i.e. provisioning, regulating, cultural, supporting services), opening up the scope of CS by including relevant issues (e.g. land use, soil-water-nutrient nexus, genetic resources, biological control, cultural values) that are currently missing or overlooked. The concept of CS is also criticized as it often discusses the sustainability dimensions in a compartmentalized manner (Lozano and Huisinigh, 2011). As shown in our framework, an ecosystem services approach can promote a more holistic view on interlinked economic, social and environmental issues. This facilitates the analysis of trade-offs and synergies between sustainability dimensions, and therefore a more comprehensive and cross-cutting comparison between different economic actors and sectors. Furthermore, by taking into account ecosystem services, our framework advocates a passage from the concept of corporate social responsibility (CSR) to that of more inclusive CS (Montiel, 2008). Under CSR, the natural environment is commonly seen as a passive subject, accounted for only through stakeholders’ interests. However, ecological limits are not necessarily embedded and expressed in stakeholders’ preferences. As it emerged from this study and from recent literature, recognizing ecological limits is however increasingly pivotal to companies’ performance. A richer conceptualization of CS should therefore not only include phenomenological trade-offs between stakeholders’ preferences – already central to CSR (Sethi, 1979; van Marrewijk, 2003) - but also ecological limits, as expressed in the concept of planetary boundaries (Whiteman et al., 2013).

Our operational framework could additionally contribute to addressing the concurrent debate on the global-local level implementation of CS, i.e. whether sustainability practices follow from a global standardisation process or rather respond to local-level issues and drivers (e.g. Bondy and Starkey, 2012; Muller, 2006). This contributes to highlighting eventual mismatches and gaps between local impacts and dependencies on ecosystem services, and related response strategies and practices. Response practices are often more standardised for international companies than for locally operating companies (Bondy and Starkey, 2012). On one hand, this is beneficial for introducing high-standard practices in different locations, especially in the context of developing and emerging economies. Our findings suggest that several corporate response practices addressing ecosystem services often act as standard, “umbrella” solutions to several issues. In this regard, targeting

ecosystem service bundles that are universal may thus provide synergistic solutions. On the other hand, in some cases a context-specific approach may be called for while some individual issues could possibly be better addressed with tailored measures. For example, buffer zones target the biodiversity-water-soil-nutrients nexus, while carbon trading is an example of an ecosystem service-specific response (Table 7).

Table 7 Examples of responses practices to specific impacts and dependencies, and related business risks and opportunities.

Assessment instruments	Dependencies		Impacts	Risks	Response practices	Opportunities
	Positive	Negative				
Resource inventory	Timber	na	Timber quality and species portfolio	na	Certification	Attracting sustainability-driven customers; Securing availability and sustainability of resources
Mapping ecologically sensitive areas; Environmental monitoring	Water, soil, nutrient cycling	na	Water, soil, nutrient cycling	Ecosystem degradation	Buffer zones around ecologically sensitive areas; Green fertilizers	Anticipating regulation
Monitoring of natural hazards	na	Floods, typhoons	na	Operation disruption; Threat to productivity	R&D	Securing operation continuity and productivity
Carbon accounting	na	na	Carbon emission and storage	Climate change may affect productivity	Carbon trading	Contributing to climate change mitigation
Mapping culturally sensitive areas e.g. graves location	na	na	Cultural values	Conflict with local communities	Buffer zones around graves	Engaging with local communities

Adopting an ecosystem services approach in CS can be pursued by creating new instruments or expanding the existing ones to include ecosystem services. As one of our interviewees suggested: “...it would be more powerful and valuable if such aspects could be integrated into *Environmental Impact Assessment*, [which] is required by the law and is a fundamental procedure

for every (forest-based) company". On the other hand, introducing additional tools for biodiversity and ecosystems also means "new procedures, data and assessors" for companies (van den Burg and Bogaart, 2014, p.183). A more complementary approach could therefore involve identifying and building upon existing instruments that already indirectly relate to ecosystem services. In our findings, the interviewees listed existing tools for assessing and mitigating corporate impacts and dependencies on the environment and society (e.g. among others, EIA, environmental monitoring and mapping, carbon accounting, certification, or use of buffer zones).

Future research opportunities include the further investigation of the role of business and other non-state agents in managing common-pool natural resources, such as water, soil and biodiversity (Kurland and Zell, 2010). Efforts should be directed towards investigating solutions for integrating ecosystem services into CS disclosure, including a more comprehensive qualification and quantification of ecological impacts and dependencies. Scientific research is for example on how to operationalize the concept of ecosystem services in corporate sustainability (e.g. Chaplin-Kramer et al., 2015; Othoniel et al., 2016).

In addition, there is emerging a wide space of discussion for ecosystem service-based, voluntary governance instruments for the private sector, for instance via ecosystem stewardship or economic instruments. This includes the assessment of available public and private governance instruments from a sector-specific viewpoint, and consideration of the appropriateness of each instrument according to its context (e.g. polluter pays, beneficiary pays principles). As land use and land tenure emerged as a dominant theme in our study, better understanding of company-local community relationships would constitute an interesting follow-up research topic in the forestry context (see also e.g. Dare et al., 2014). The development of these research areas would benefit from multi-disciplinary research, partnership-based cooperation, and the use of hybrid methodologies and creative approaches. In this regard, engagement between researchers and the private sector is important (Gummesson, 1991), as tacit knowledge of employees can be particularly useful in environmental management, including problem identification and management, and the development of preventive solutions (Boiral, 2002). As observed in our study, research opportunities also include acknowledging the limitations of and possible solutions to (e.g. indirect questioning, Fisher, 1993) social desirability bias in interview-based research on delicate topics, such as corporate sustainability in the context of Chinese culture.

Furthermore, there is a need for further "integration of theory and data from natural sciences within the business literature" (Whiteman et al., 2013, p.309) and the investigation of regulatory and socio-cultural forces behind expectations and development of corporate action (Humphreys, 2014). Traditional economic theory implies substitutability of natural capital, for instance

through technological innovation. Developing technological solutions can be promising for some sustainability issues, such as energy-dependency (Jacobson, 2008). However, perfect substitutability of ecosystem services is unlikely, and perhaps undesirable from a normative viewpoint. Ecosystems are highly complex and multi-functional, and therefore it is often impossible to artificially replicate their functional properties. In addition, occurring global environmental changes are mostly non-linear and irreversible (Dyllic and Hockerts, 2005). Therefore, business scholars could benefit from adopting and operationalizing a perspective where economy, society and ecosystems are interlinked and nested, with business, as a component of society, and embedded in and conditional to a biophysical world (Giddings et al., 2002). In this regard, research opportunities include the development of a more holistic framework to enable the conceptualization of complex linkages among businesses, ecosystems and the surrounding society.

Finally, acknowledging the intrinsic value of ecosystem services leads to the question: who is responsible for ensuring sustainability? Large scale corporations have an increasing influence on global level agenda- and rule- setting by holding discursive and persuasive power (Fuchs and Lederer, 2007), as recently witnessed in the process of designing new Sustainable Development Goals. Attention should, however, not be diverted from the public character of biodiversity and ecosystems, and from the role of individual consumers and citizens (van den Burg and Bogaart, 2014).

Appendix

Table 8 Glossary of terms used in the conceptual framework.

Term	Definition
Impact	Positive / negative effect exercised on the environment and society, e.g. local development / pollution.
Dependency	Biophysical / human input affecting company's success, e.g. natural resources / work force. Dependencies can be positive (ecosystem services) or negative (ecosystem disservices).
Risk	Disadvantage deriving from ignoring impacts and dependencies, e.g. increased labour and logistics costs, competition for resources and land, stricter regulation, customers and financing sources.
Opportunity	Advantage gained via a corporate action addressing impacts and dependencies e.g. complying and anticipating regulation, securing resources, attracting sustainability-driven customers and investors.
Response practice	Corporate action that can mitigate impact and dependencies, and may provide business opportunities, e.g. reducing water consumption.
Assessment instrument	A tool to detect or monitor business impacts and dependencies on ecosystem services.

ⁱ The ecosystem services concept is a short-term tool for advocating environmental conservation in dominant, efficiency-based decision-making. This concept adopts a human-centric perspective and a reductionist approach, where single benefits from nature are extrapolated for examination from the holistic system of thinking adopted in natural sciences. Critical literature argues that such a utilitarian framing of nature can “induce logics of individualism”, commodification and privatization, and undermine “the moral sentiment for conservation” (Gómez-Baggethun et al., 2010, p.1216).

ⁱⁱ We define CS as awareness of and pro-activeness towards social and environmental issues, in reference to the Brundtland's concept of sustainable development. Sustainability issues include addressing stakeholders' expectations, as well as ecological limits. In our paper the term CS is also used in reference to literature on corporate social (CSR) responsibility, as these concepts are closely connected.

ⁱⁱⁱ Ecosystems are neither benevolent nor malevolent: while they provide ecosystem services, they may also cause disservices, conflicting with human well-being and productivity. Human activities, however, can cause or exacerbate ecosystem disservices (Zhang et al., 2007). For example, pesticide use can induce genetic resistance in pests and pathogens, triggering outbreaks. The loss of natural habitat and landscape complexity moreover reduces ecosystem capacity to mitigate these phenomena. There is, evidently, a feedback between human actions and nature's reactions.

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